"And as he passed over Penuel, *the sun rose upon him*, and he [Jacob] *halted upon his thigh*" (*Genesis* xxxii, 31). *Israel*-Jacob, opposed by his brother Esau, is *Samael*, and "the names of Samael are Azâzêl and *Satan*" (the opposer).

[Sama *sulu*, current.]

Samael (current) (Opposition/resistance)

impedance, (Im-pēd'ns) in electricity, measure of the degree to which an electric circuit **resists** electric-current flow when a voltage (see potential, electric) is impressed across its terminal. Impedance, expressed in **ohms**, is the ratio of the voltage impressed across a pair of terminals to the current flow between those terminals

VEDA (Skt., "knowledge"),

the most ancient sacred literature of Hinduism (q.v.) , or individual books belonging to that literature. This body of ancient literature consists primarily of four collections of hymns, detached poetical portions, and ceremonial formulas. The collections are called the Rig-Veda, the Sama-Veda, the YajurVeda, and the Atharva-Veda. They are known also as the Samhitas (roughly "collection").

YOGA (Skt. yuga, "yoke"), Matt 11:29 -

Matt 11:29 Take my yoke upon you, and learn of me; for I am meek and lowly in heart: and ye shall find
rest unto your souls.
30 For my yoke is easy, and my burden is light.

Samael - ask questions - Resist -

(7) Meditation (dhya na) fixes the mind on the object of knowledge, especially Brahma, to the exclusion of all other thoughts. (8) Profound contemplation (sama dhi) is the perfect absorption of thought in the object of knowledge, its union and identification with that object.

So it is the samadhi which overcomes the opposition Samael. It is the key. the symbol of 8, azozeo, 4555. The object of knowledge in meditation.

Blavatsky put it this way."Phantasy is an impediment to our intellectual conceptions and hence when we are agitated by the inspiring influences of divinity, if the phantasy intervenes the enthusiastic energy ceases. For enthusiasm and the phantasy are contrary to each other.

And what is Phantasy

phan·tasm (făn'tăz'əm) *n.* **1.** Something apparently seen but having no physical reality; a phantom or an apparition. Also called phantasma. **2.** An illusory mental image. Also called phantasma. **3.** In Platonic philosophy, objective reality as perceived and distorted by the five senses.

It is religion. It is emotionalism. It is feeling. The things that so many in religion seek. And yet it is the very thing that will intervene and oppose our union with God. It is Samael.

It is Fantasy

fan·ta·sy (făn'tə-sē, -zē) *n.*, *pl.* **fan·ta·sies**. **1.** The creative imagination; unrestrained fancy. See Synonyms at **imagination. 2.** Something, such as an invention, that is a creation of the fancy. **3.** A capricious or fantastic idea; a conceit. **4.a. Fiction characterized by highly fanciful or supernatural elements.**

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direct current

direct current *noun*
Abbr. **dc**, **DC**
An electric current flowing in one direction only.

al·ter·nat·ing current

al·ter·nat·ing current (ôl′tər-nā′tĭng, ăl′-) *noun*
Abbr. **ac**, **AC**
An electric current that reverses direction in a circuit at regular intervals

resistance

resistance, (rĭ-zĭs′təns) property of an electric conductor by which it **opposes** flow of electricity and dissipates electrical energy **away from the electric circuit,** usually as heat. Resistance is basically the same for alternating- and direct-current circuits. A high-frequency alternating current, however, tends to travel near the surface of a conductor. Because such a current uses less of the available cross section of the conductor, it meets with more resistance than direct current. **The unit of resistance is the ohm**. See also conduction; impedance; **Ohm's law;** superconductivity

brain wave

brain wave *noun*
1. A rhythmic fluctuation of electric potential between parts of the brain, as seen on an electroencephalogram.
2. *Informal.* A sudden inspiration.

Abbr. **EEG**
A graphic record of the electrical activity of the brain as recorded by an electroencephalograph. Also called *encephalogram.*

brain wave n (1890)
a : rhythmic fluctuations of voltage between parts of the brain resulting in the flow of an electric current
b : a current produced by brain waves

Computer — Brain
Man — Applicated — God
Ram — Outer Memory — Rams Horn — Ram Head

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gate[1] (gāt) *n.* **1. 9.** *Electronics.* A circuit with multiple inputs and one output that is energized **only when a designated set of input pulses is received. -. 2.** *Electronics.* To select part of (a wave) for transmission, reception, or processing by magnitude or time interval. Psalm 118 Isaiah 24:12 Galatians 4:25 city -

Stedmans Medical Dictionary

gating
gāt′ing

1. In a biological membrane, the opening and closing of a channel, believed to be associated with changes in integral membrane proteins.

2. A process in which electrical signals are selected by a gate, which passes such signals only when the gate pulse is present to act as a control signal, **or passes only the signals that have certain characteristics. See: gate.**

FUNK & WAGNALLS

Everything that a digital computer does is based on one operation: the ability to determine if a switch, or "gate," is open or closed. That is, the computer can recognize only two states in any of its microscopic circuits: on or off, high voltage or low voltage,

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Using extensive light measurements made by the Pioneer 10 and 11 spacecraft, a NASA scientist has produced "celestial constants" that will be highly useful to astronomers and physicists. The new constants are the first "pure" measurements of the various kinds of background light in our solar system, galaxy and universe.

Work conducted by Dr. Gary Toller, Goddard Space Flight Center, Greenbelt, Md., and General Sciences Corp., Laurel, Md., indicates that background light from beyond the solar system is made up of approximately 82 percent light from faint stars. Most of the remainder is galactic light diffused by dust; the final proportion, less than 0.6 percent of background light, originates beyond the galaxy.

Since much of the knowledge of the universe comes from visible light, the data will provide a benchmark in many fields of astronomy and physics. The Pioneer 10 and 11 photo-polarimeter measurements have provided the first observations of incoming light without interference of solar system light. The Pioneers are managed by NASA's Ames Research Center, Mountain View, Calif., for the agency's Office of Space Science and Applications.

The new work, combined with other measurements, also provides a clue to chemical composition of solar, galactic and cosmic dust. It gives an accurate measure of the Sun's position above the plane of the galaxy (about 12 parsecs). It describes how cosmic dust scatters light. For the entire celestial sphere, 60 percent of light is scattered, not absorbed, predominantly in the same direction it had been travelling in.

Toller has used his data as another way to calculate total amounts of visible matter in the universe. These calculations confirm other estimates that 90 percent of matter in the universe is "missing" or unseen dark matter. The universe is a mind.

Cosmic Consciousness Science can only see 10% DNA We use 10% Brain See 10% Universe

Toller and others used a variety of observations from Earth for the analyses, combining data on the quantities of stars and types of stars with computer models of light scattering in the galaxy, amounts of dust and gas and size of particles. Then he compared these models to measurements made by the Pioneers as the two spacecraft moved out of the solar system.

The new data will help investigators study diffuse celestial light sources such as zodiacal light, which reaches Earth after being reflected by nearby dust. For an astronomer on Earth, looking in a random direction in space, 40 percent of incoming light is zodiacal light.

Diffuse Spread in different directions light rates by an angle

Once the Pioneers were beyond 300 million miles, the zodiacal light diminished to a negligible level and scientists were able to make the first pure measurements of background light from beyond the solar system in the mid-1970s. Since then, the long flight paths of the Pioneers have made it possible to make very exact measurements of this "outside" light.

Background light from beyond the solar system breaks down into integrated starlight from stars too faint to be seen by the eye, diffused galactic light reflected by dust particles in the galaxy and light coming from outside the galaxy.

Toller, who reported his work at an international conference on galactic and extragalactic background radiation in Germany earlier this year, is continuing to refine and apply the data. Dr. Jerry Weinberg of the Institute for Space Science and Technology,

os, gen. o'ris, pl. or'a [L. mouth]. 1. [NA]. The mouth. 2. Term applied sometimes to an opening into a hollow organ or canal, especially one with thick, or fleshy edges

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i'ris, pl. ir'ides [G. rainbow. The iris of the eye. IRIS] [NA]. The anterior division of the vascular tunic of the eye, a disklike diaphragm, perforated in the center (the pupil), attached marginally to the ciliary body; it is composed of stroma and a double layer of pigmented retinal epithelium from which are derived the sphincter and dilator muscles of the pupil.

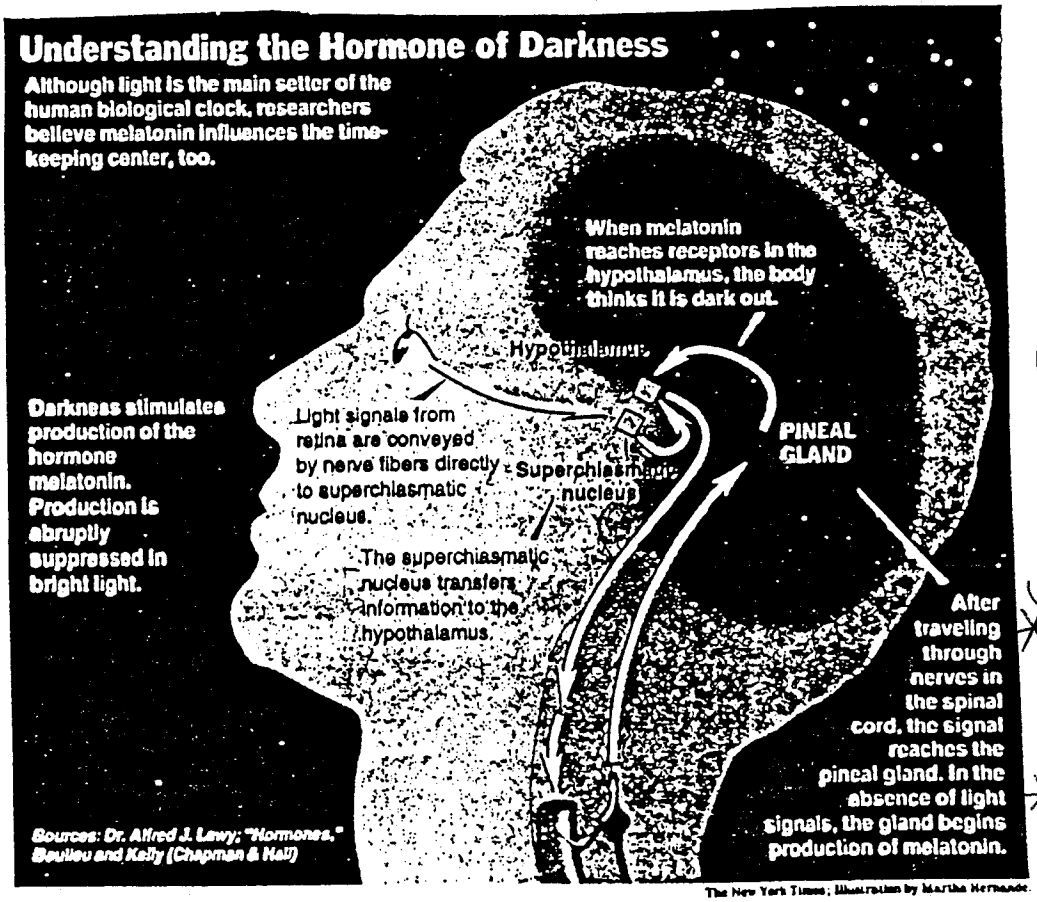
Stedmans Medical Dictionary

OS open Iris - Eye

OSIRIS

5 And I saw in the right hand of him that sat on the throne a book written within and on the back side, sealed with seven seals.

Revelation 5:1



NY Times

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Supernova 1987A

65

National Geographic April 97 Color pic of supernova

HUBBLE FINDS MYSTERIOUS RING STRUCTURE AROUND SUPERNOVA 1987A

NASA's Hubble Space Telescope (HST) has obtained the best images yet of a mysterious mirror- imaged pair of rings of glowing gas that are encircling the site of the stellar explosion supernova 1987A.

One possibility is that the two rings might be "painted" by a high-energy beam of radiation or particles, like a spinning light- show laser beam tracing circles on a screen. The source of the radiation might be a previously unknown stellar remnant that is a binary companion to the star that exploded in 1987. Images taken by Hubble show a dim object in the position of the suspected source of the celestial light show. "The Hubble images of the rings are quite spectacular and unexpected," says Dr. Chris Burrows of the European Space Agency and the Space Telescope Science Institute in Baltimore, Maryland. Burrows used the Wide-Field and Planetary Camera (WFPC2) of the Hubble Space Telescope to image the rings in February, 1994.

The striking Hubble picture actually shows three rings. The smaller "center" ring of the trio was seen previously. The larger pair of outer rings were also seen in ground-based images, but the interpretation was not possible until the higher resolution Hubble observations. Though all of the rings probably are inclined to

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our view (so that they appear to intersect), they probably are in three different planes. The small bright ring lies in a plane containing the supernova; the two rings lie in front and behind it.

To create the beams illuminating the outer rings, the remnant would need to be a compact object such as a black hole or neutron star with a nearby companion. Material falling from the companion onto the compact object would be heated and blasted back into space along two narrow jets, along with a beam of radiation. As the compact object spins it might wobble or precess about its axis, like a child's top winding down. The twin beam would then trace out great circles like jets of water from a spinning lawn sprinkler. If the rings are caused by a jet, however, the beams are extremely narrow (collimated to within one degree). This leads Burrows to conclude: "This is an unprecedented and bizarre object. We have never seen anything behave like this before." The jet model explains why the rings appear to be mirror imaged, and why they appear to be symmetrical about a point offset from the center of the explosion.

Burrows got the idea for the beam explanation when he noticed that where a ring appears brighter, an equally bright region appears on opposite ring. By connecting lines between the similar clumps on opposite rings Burrows found a common center. However, it is offset from the heart of the supernova ejecta. When Burrows did a detailed inspection of the HST image, he found a dim object which may be the source of the beam at the predicted location. The object is about 1/3 light-year from the center of the supernova explosion.

From previous HST observations and images at lower resolution taken at ground-based observatories, astronomers had expected to see an hourglass-shaped bubble being blown into space by the supernova's progenitor star. "The rings are probably on the surface of the hourglass shape," says Burrows. The hourglass was formed by a wind of slow-moving gas that was ejected by the star when it was a red supergiant, and a much faster wind of gas that followed during the subsequent blue supergiant stage. The hourglass was produced by the fact that the stellar wind from the red giant was denser in the equatorial plane of the star. When the star reached the blue supergiant stage, the faster winds tended to break out at the poles of the star. Energetic radiation from the supernova explosion illuminated the dense gaseous material in the equatorial "waist" of the hourglass, causing it to glow -- thus explaining the central bright ring. However, the two outer rings might be painted on the surface of the hourglass by a very different process, by the beams from the stellar remnant. Further observations with HST will study any further changes that might occur. In particular, if a remnant companion really exists, it should collide with the supernova's expanding cloud of ejecta in the mid 1990s.

curse that robs him of his spirituality and blinds him to the truth of his mission.

sion. Let us attempt to understand — at least imperfectly — how Torah permeates every molecule of the universe. If we succeed, we will have found the first marker on the road to fulfillment as the Creator intended it.

חמשים שערי בינה נבראו בעולם וכולן נתנו למשה חסר אחד

Fifty gates of understanding were created and all were transmitted to Moses save for one (Rosh Hashana 21b).

What were these 'gates of understanding?' *Ramban* (Introduction to Torah) explains that each order of the universe was created according to a plan, and its content, growth, function, and all other of its aspects are determined according to it. To enter into the mysteries of this plan and to comprehend it is to be admitted into its 'gate of understanding'. The lowest order of creation is דּוֹמֵם, the inanimate objects like rocks, sand, water. Above it comes צוֹמֵחַ, simple plant life, trees; חַי, the various living creatures until, as one goes higher and higher on the ladder of the universe, he reaches מְדַבֵּר, man — the only creature possessing the power of intelligent speech, and a human soul. The knowledge of man is the forty-ninth gate of understanding, the ability to know the complexities of the human mind and personality.

To enter into mysteries of this plan and to comprehend it is to be admitted into its 'gate of understanding'.

The Fifty Gates

Above that gate is the fiftieth — the knowledge of God. Forty-nine gates were presented to Moses; the fiftieth was denied even him, for no mortal being can attain the understanding of God. Thus, in the truest sense, *Ramban* continues, the fiftieth gate was never 'created', for the term creation implies that it was part of heaven and earth — part of the handiwork of the Six Days of Creation that is within the realm of human dominion and understanding. But that gate, the ability to comprehend and understand the essence of God, was never *created* in the normal sense, because it is beyond the scope of man.

The ability to comprehend and understand the essence of God, is beyond the scope of man.

[*Chidushei HaRim*, in a piercing insight, suggests that not only was the 'fiftieth gate' *created*, as implied by the above Talmudic text, but it was even *transmitted* to Moses! The very fact that a human being can conceive God's greatness to the extent that he can say 'if all the seas were ink and all the heavens parchment and all the trees quills I could not begin to write Your greatness' — this in itself is a glimmer of the glories within the fiftieth gate of understanding. This barest breath of the last gate was transmitted to man; otherwise how could he ever imagine that the unimaginable exists, how could his soul soar in futile

This barest breath of the last gate was transmitted to man; otherwise how could he ever imagine that the unimaginable exists, how could his soul soar in futile yet fruitful quest of the infinite riches of God's wisdom and spirituality?

Computing
Glossary of Computer Terms

Computer

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computer Any machine that does three things: accepts structured input, processes it according to prescribed rules, and produces the results as output.

medulla ob·lon·ga·ta

Psalm 24:11

= long gate

medulla ob·lon·ga·ta (ŏb´lŏng-gā¹tə) *noun*
plural **medulla ob·lon·ga·tas** or **medullae ob·lon·ga·tae** (-gā¹tē)
The lowermost portion of the vertebrate brain, continuous with the spinal cord, responsible for the control of respiration, circulation, and certain other bodily functions.

[New Latin : Latin *medulla*, medulla + New Latin *oblongata*, oblong.]

logic circuit

logic circuit, electric circuit whose output depends upon the input in a way that can be expressed as a function in symbolic logic; it has one or more binary inputs (capable of assuming either of two states, e.g., "on" or "off") and a single binary output. Logic circuits that perform particular functions are called gates. Basic logic circuits include the AND gate, the OR gate, and the NOT gate, which perform the logical functions *AND, OR,* and *NOT.* Logic circuits, which are mainly used in digital computers, can be built from any binary electric or electronic devices, including switches, relays, electron tubes, solid-state diodes, and transistors.

A

Mitochondria are the powerhouses of the animal cell, where the products of the enzymatic breakdown, or metabolism, of nutrients such as glucose are converted into energy in the form of the molecule adenosine triphosphate (ATP). This process uses up oxygen and is called aerobic respiration. Plants possess, in addition to mitochondria, similar organelles called chloroplasts. Each chloroplast contains the green pigment chlorophyll, which is used to convert light energy from the sun into ATP. This process is called **photosynthesis** ` (q.v.) .
Cilia and Flagella.

B

(ATP), molecule found in all living organisms that is the main immediate source of usable energy for the activities of the cells. ATP is built up by the metabolism of foodstuffs in the cell in special compartments called mitochondria. Because the energy-exchanging function of ATP and the catalytic (work-boosting) function of enzymes are intimately

C

BIOENERGETICS,
study of the processes by which living cells use, store, and release **energy** (q.v.) . A central component of bioenergetics is energy transformation, the conversion of energy from one form to another.
All cells transform energy. Plant cells, for example, use sunlight to make carbohydrates (sugars and starches) from simple inorganic chemicals. In this process, called **photosynthesis** ` (q.v.) , radiant energy from the sun is converted into stored chemical energy. If these plant carbohydrates are eaten by an animal (*see* **Food Web**), they will be broken down and their chemical energy turned into movement (kinetic energy), body heat (radiant energy), or new chemical bonds (*see* **Adenosine Triphosphate** ; **Citric Acid Cycle** ; **Metabolism**).

D

Szent- Gyö r· gyi, Albert von Nagyrapolt \sānt-' jörj(-e)\ . 1893- 1986. American biochemist, b. Budapest. Researcher at U. of Szeged, Hung. (1931- 45). To U.S. (1947); director of Institute for Muscle Research, Woods Hole, Mass. (from 1947). Authority on muscular physiology; discovered actin, a protein in muscle that is partly responsible for muscular contraction; showed that adenosine triphosphate (ATP) is the immediate source of energy for contraction. Awarded 1937 Nobel prize for physiology or medicine for discoveries about the roles of organic compounds, esp. vitamin C, in the oxidation of nutrients by the cell.

É

signal
signal *[n]*
indication; authorization
alarm, alert, beacon, bleep, blinker, cue, flag, flare, gesture, go-ahead*, green light*, high sign*, indicator, mark, Mayday*, movement, nod, okay*, omen, sign, SOS*, tocsin, token, wink
See *~74: SIGNAL* , *~284: SYMBOL* , *~529: COGNITIVE* , *~685: OF AUTHORIZATION*

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zodiacal light

A

zodiacal light or green flash, faint band of light sometimes seen just after sunset or before sunrise, extending up from the horizon at the sun's setting or rising point. It is caused by reflection of sunlight from tiny dust particles concentrated in the plane of the ecliptic.[1]

chlorophyll

B

chlorophyll, (klôr'e-fil) green pigment in plants that gives most their color and enables them to carry on the process of photosynthesis. Chlorophyll, found in the chloroplasts of the plant cell, is the only substance in nature able to trap and store the energy of sunlight. The light absorbed by chlorophyll molecules is mainly in the red and blue-violet parts of the visible spectrum; the green portion is not absorbed but reflected, and thus chlorophyll appears green.[2]

Structure

C

Human hemoglobin consists of four polypeptide units, called globins, each of which contains a heme group with a central iron atom that can bind loosely to a molecule of oxygen. The heme group is chemically related to chlorophyll, the green pigment of plants.

Bright Nebulae

D

Bright nebulae are clouds or wisps of gas that glow or scatter starlight. There are two main types of bright nebulae: emission and reflection, both of which are associated with star birth. The gases of an emission nebula glow, mainly in the red or green part of the spectrum, because they are heated by hot young stars inside the nebula. The dust in a reflection nebula scatters light from young stars in or around it.

E

Control by Extracellular Signals

More radical alterations in cell function are produced by extracellular signals. A bacterium (such as *Escherichia coli*, which lives in the human digestive system) can sense changes in its external environment, and will move toward a source of nutrients and away from a noxious chemical. Single-celled green algae can sense and move toward a source of light.

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Fundamental Particles

PARTICLE PHYSICISTS group fundamental particles into three categories: quarks, leptons, and gauge bosons. Quarks combine to make heavy particles such as protons and neutrons. Leptons are lightweight particles such as electrons and positrons. Gauge bosons are particles with no mass that transmit all forces in the Universe. The gluon, for example, is a gauge boson that binds together quarks within atomic nuclei. The force carried by gluons is strong enough to prevent protons, which are made of quarks but are all positively charged, from repelling each other.

Gauge Bosons - Replace Spirit

Gauge bosons are a family of fundamental particles that act as "messenger particles" carrying the fundamental forces of nature. The most common example is the photon, which acts as a carrier for the electromagnetic force. Gauge bosons exist for the other fundamental forces, too: transmit all the forces in world -

1st messenger = light

2nd messenger = Chemical in you

Second Messengers

Second messengers are chemicals produced within a cell in response to an extracellular signal that acts at the cell membrane. The second messenger then activates the cell's intracellular biochemical machinery to produce the appropriate response to the signal.

Many of the hormones and neurotransmitters that cells use to communicate with each other act through second messengers. The primary signal is intercepted at the cell surface by receptor proteins, which communicate with the interior of the cell. The stimulation of the cell-surface receptor leads to the production of a second messenger within the cell.

Hundreds of molecules of the second messenger may be produced for each receptor protein stimulated, so that second messengers also have the effect of amplifying the original signal. This amplification factor explains why, for example, a single photon of light hitting a photoreceptor rod cell in the eye can be sufficient to trigger a nerve impulse and enable us to see in very dim light.

Types of Second Messengers

Although humans and other animals make use of hundreds of different chemical signals and their corresponding receptors, these act through a much smaller number of second messengers. The main second messengers used by animal cells are: cyclic AMP and cyclic GMP; inositol trisphosphate; diacylglycerol; and calcium ions (Ca^{2+}).

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response.

Cyclic AMP – is the 2nd messenger

Cyclic AMP is used as a second messenger throughout the animal kingdom, but not, so far as is known, in plants. It was the first second messenger to be discovered, in 1957. It is formed by the action of the enzyme adenylate cyclase on ATP. Stimulation of the appropriate cell-surface receptor temporarily activates the adenylate cyclase, which is attached to the inner face of the cell membrane. Cyclic AMP production is increased, and the concentration within the cell rises sharply. The cell's response is automatically time-limited by another enzyme, which breaks down cyclic AMP almost as soon as it is produced, and brings the level back to normal. This resets the cell, enabling it to be stimulated again.

natural of DNA

Direct impact from sun to ATP.
green light - new energy - signal triggered

CHLOROPHYLL,
the pigment in plants that gives them their green color and that absorbs the light necessary for **photosynthesis** (q.v.), the chemical reaction that converts light energy to chemical energy. Chlorophyll absorbs mainly red, violet, and blue light and reflects green light. The great abundance of chlorophyll in leaves and its occasional presence in other plant tissues, such as stems, causes these plant parts to appear green. In some leaves, chlorophyll is masked by other pigments. In fall, chlorophyll wanes in the leaves of trees, and other pigments predominate.

Chlorophyll is a large molecule composed mostly of carbon and hydrogen. At the center of the molecule is a single atom of magnesium surrounded by a nitrogen-containing group of atoms called a porphyrin ring. The structure somewhat resembles that of the active constituent of hemoglobin in the blood. A long chain of carbon and hydrogen atoms proceeds from this central core and attaches the chlorophyll mol ecule to the inner membrane of the chloroplast, the cell organelle in which photosynthesis takes place. As a molecule of chlorophyll absorbs a photon of light, its electrons become excited and move to higher energy levels (*see* **Photochemistry**). This initiates a complex series of chemical reactions in the chloroplast that enables the energy to be stored in chemical bonds.

Sev-eral kinds of chlorophyll exist. They differ from each other in details of their molecular structure and absorb slightly different wavelengths of light. The most common type is chlorophyll a, making up about 75 percent of the chlorophyll in green plants. It is also found in blue-green algae and in more complex photosynthetic cells. Chlorophyll b is an accessory pigment present in plants and other complex photosynthetic cells; it absorbs light energy of a different wavelength and transfers it to chlorophyll a for ultimate conversion to chemical energy. Other chlorophylls, of minor importance, are found in some bacteria. M.R. C. & P.H.R.

fulfills a promise - (Daniel 11:31)
rebuilds the 2nd Temple in

Meditation

Pineal gland - reacts to light
5 light melatonin flows
Receptor for light
Matt 6:22 - Eye single
Genesis 32:30 - Place Pineal
Luke 11:52 - loss of Key of Knowledge
1 Kings 6:8
Matt 24:15 - get up to high place
mind is most obsolete place in body

Importance of Meditation
Why to do it

* 2nd temple most important thing in Religion and its in each of us.

electric
1 electric \i-'lek-trik, e-\ adj [NL electricus produced from amber by friction, electric, fr. ML, of amber, fr. L electrum amber, electrum, fr. Gk elektron; akin to Gk elektor beaming sun] (1675)
1 or electrical \-tri-kel\ : of, relating to, or operated by electricity

electroencephalograph

ē-lek′trō-en-sef′ă-lō-graf

A system for recording the electric potentials of the brain derived from electrodes attached to the scalp.

Origin

[electro- + G. *encephalon,* brain, + *graphō,* to write]

electrocorticogram

ē-lek-trō-kōr′ti-kō-gram

A record of electrical activity derived directly from the cerebral cortex.

HISTORY OF MODERN PARTICLE PHYSICS

The history of modern particle physics has gone through four stages. In the first stage, Joseph J. THOMSON discovered (1897), by studying electricity passing through gases, that all atoms contain certain particles, called ELECTRONS, that carry a negative electric charge. Because atoms are electrically neutral, there must be balancing positive charges somewhere in the atom. Ernest RUTHERFORD proposed (1911), based on a series of experiments by Hans GEIGER and Ernest Marsden, that these

chain reaction, nuclear

In nuclear fission, a chain reaction is a self-sustaining sequence of fissions. Fission is initiated when a uranium-235 nucleus is penetrated by a neutron; if the nucleus splits, it liberates, on the average, about 2.5 additional neutrons that may cause other nuclei to undergo fission. Some neutrons escape and others are lost through radiative capture. In order to produce a chain reaction, each fission must produce at least on neutron that initiates another fission. The minimum amount of fissionabl material required for a self-sustaining chain reaction is the critical mass of the material. The first man-made chain reaction was achieved on Dec. 2, 1942, as part of the MANHATTAN PROJECT.

Gibson, W. M., The Physics of Nuclear Reactions (1980).

U·ra·nus (yŏŏr′ə-nəs, yŏŏ-rā′nəs) *n.* 1. *Greek Mythology.* **The earliest supreme god, a personification of the sky, who was the son and consort of Gaea and the father of the Cyclopes and Titans.** 2. **The seventh planet from the sun, revolving about it every 84.07 years at a distance of approximately 2,869 million kilometers (1,790 million miles), having a mean equatorial diameter of 52,290 kilometers (32,480 miles) and a mass 14.6 times that of Earth. [Late Latin *Ūranus,* from Greek *ouranos,* heaven, Uranus.]**

formula. Detailed comparison of the formula with many experiments showed close agreement in every respect, implying convincingly the correctness of Rutherford's nuclear model of the atom.

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Nuclear Transformations.

The discovery of the nucleus raised new questions concerning the structure of the nucleus itself. Was it actually a point or did it have finite size? Was it composed of more elementary particles? Radioactivity had been shown to be the result of TRANSMUTATION OF ELEMENTS; for example, an atom of uranium becomes an atom of thorium by emitting an alpha particle. This could now be understood as a nuclear transformation

all happens in world of atom

Printed from The World Book Multimedia Encyclopedia

Uranium = means = heaven

ATOM

thorium = monazite = to be alone

Atom is one of the basic units of matter. Everything around us is made up of atoms. An atom is incredibly tiny—more than a million times smaller than the thickness of a human hair. The smallest speck that can be seen under an ordinary microscope contains more than 10 billion atoms. The diameter of an atom ranges from about 0.1 to 0.5 nanometer. A nanometer is a billionth of a meter, or about $^{1}/_{25,000,000}$ inch.

Atoms form the building blocks of the simplest substances, the *chemical elements*. Familiar elements include hydrogen, oxygen, iron, and lead. Each element consists of one basic kind of atom. *Compounds* are more complex substances made of two or more kinds of atoms linked in units called *molecules*. Water, for example, is a compound in which each molecule consists of two atoms of hydrogen linked to one atom of oxygen.

Atoms vary greatly in weight, but they are all about the same size. For example, an atom of plutonium, the heaviest element found in nature, weighs more than 200 times as much as an atom of hydrogen, the lightest known element. However, the diameter of a plutonium atom is only about 3 times that of a hydrogen atom.

The parts of an atom

Tiny as atoms are, they consist of even more minute particles. The three basic types are *protons*, *neutrons*, and *electrons*. Each atom has a definite number of these *subatomic* particles. The protons and neutrons are crowded into the *nucleus*, an exceedingly tiny region at the center of the atom. If a hydrogen atom were about 4 miles (6.4 kilometers) in diameter, its nucleus would be no bigger than a tennis ball. The rest of an atom outside the nucleus is mostly empty space. The electrons whirl through this space, completing billions of trips around the nucleus each millionth of a second. The fantastic speed of the electrons makes atoms behave as if they were solid, much as the fast-moving blades of a fan prevent a pencil from being pushed through them.

Atoms are often compared to the solar system, with the nucleus corresponding to the sun and the electrons corresponding to the planets that orbit the sun. This comparison is not completely accurate, however. Unlike the planets, the electrons do not follow regular, orderly paths. In addition, the protons and neutrons constantly move about at random inside the nucleus.

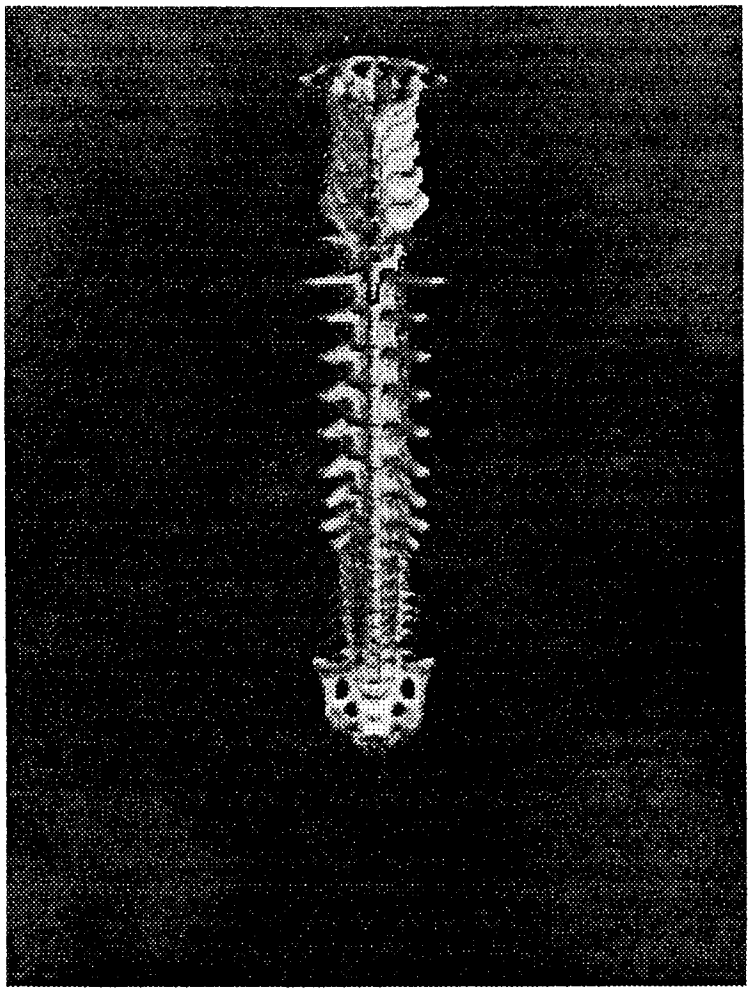
The nucleus makes up nearly all the *mass* of an atom. Mass is the quantity of matter in an atom. Each proton has a mass roughly equal to that of 1,836 electrons. It would take 1,839 electrons to equal a neutron's mass. Each proton carries one unit of positive electric charge. Each electron carries one unit of negative charge. Neutrons have no charge. Under most conditions, an atom has the same number of protons and electrons, and so the atom is electrically neutral.

Protons and neutrons are about 100,000 times smaller than atoms, but they are in turn made up of even smaller particles called *quarks*. Each proton and neutron consists of three quarks. In the laboratory, scientists can cause quarks to combine and form other kinds of subatomic particles besides protons and neutrons. All these other particles break down and change into ordinary particles in a small fraction of a second. Thus, none of them is found in ordinary atoms. However, scientists first learned that protons and neutrons consist of quarks through the study of other subatomic particles. For information on these other particles, see SUBATOMIC PARTICLE and the separate articles on subatomic particles listed in the *Related Articles* at the end of this article.

The electrons, unlike the protons and neutrons, do not seem to have smaller parts. Electrons have very little mass. The mass of an electron in grams may be written with a decimal point followed by 27 zeros and a 9.

Opposite electric charges attract. The positively charged nucleus therefore exerts a force on the negatively charged electrons that keeps them within the atom. However, each electron has energy and so is able to resist the attraction of the nucleus. The more energy an electron has, the farther from the nucleus it will be. Thus, electrons are arranged in *shells* at various distances from the nucleus according to how much energy they have. Electrons with the least energy are in inner shells, and those with more energy are in outer shells.

Each electron shell is labeled with a number. The shell closest to the nucleus is called shell 1. The other shells, in order of



Cervical Vertebrae

The cervical vertebrae are the first (upper) seven in the vertebral column. The first cervical vertebra is the atlas, so called because it directly bears the weight of the skull. The second cervical vertebra is called the axis, because it admits the rotation of the skull by allowing the atlas to pivot upon it. The other five cervical vertebrae have no names, but are called by their number (i.e., third cervical vertebra). Each of the cervical vertebra features a body (anterior, or frontal, portion) and an arch (posterior, or rear, portion). The body of each vertebra in the column bears the weight of the vertebrae above it (and the skull), while the arch serves to create a canal-like area along the spine to house and protect the spinal cord. Every cervical vertebra has a foramen (opening) in each of its transverse processes (lateral protrusions). The arch of the vertebra features a small knob or prominence, called an anterior tubercle. The anterior tubercles on the sixth cervical vertebra are particularly large and are known as the carotid tubercles.

Experiment with light evokes images of 'Star

Scientists doubt this experiment will pave the way for a means of transporting a person from one place to another.

THE ASSOCIATED PRESS

NEW YORK — Scientists have pulled off a startling trick that looks like the "Beam-me-up-Scotty" technology of science fiction.

In an Austrian laboratory, scientists destroyed bits of light in one place and made perfect replicas appear about 3 feet away.

They did that by transferring information about a crucial physical characteristic of the original light bits, called photons. The information was picked up by other photons, which took on that characteristic and so became replicas of the originals.

The phenomenon that made it happen is so bizarre that even Albert Einstein didn't believe in it. He called it spooky.

In addition to raising the rather fantastic notion of a new means of transportation, the trick could lead to ultra fast computers.

The experiment is reported in today's issue of the journal Nature by Anton Zeilinger and colleagues at the University of Innsbruck in Austria. Another research team, based in Rome, has done similar work and submitted its report to another journal.

The work is the first to demonstrate "quantum teleportation," a bizarre shifting of physical characteristics between nature's tiniest particles, no matter how far apart they are.

Scientists might be able to achieve teleportation between atoms within a few years and molecules within a decade or so, Zeilinger said.

The underlying principle is fundamentally different from the "Star Trek" process of beaming people around, but could teleportation be used on people? Could scientists extract information from every tiny particle in a person, transfer it to a bunch of particles elsewhere, and assemble those particles into an exact replica of the person?

There's no theoretical problem with that, several experts said. But get real.

"I think it's quite clear that anything approximating teleportation of complex living beings, even bacteria, is so far away technologically that it's not really worth thinking about it," said IBM physicist Charles H. Bennett. He and other physicists proposed quantum teleportation in 1993.

There would just be too much information to assemble and transmit, he and others said. Even if it were possible someday, it would be so expensive that "probably it's just as cheap to send the real person," said Benjamin Schumacher of Kenyon College in Gambier, Ohio.

Besides, Schumacher said, teleportation would "kill you and take you apart atom by atom so you could be reassembled at the other end, one hopes. It doesn't seem like a good idea to me."

Much more likely, experts said, is using teleportation between tiny particles to set up quantum computers. These devices would use teleportation to sling data around, and they could solve certain complex problems much faster than today's machines.

In the new work, scientists transferred the trait of "polarization" between photons. Light behaves like both a photon particle and as a wave. A light wave has peaks and troughs like an ocean wave, and polarization refers to the directions in which these peaks and troughs point. Photons retain this trait.

To transfer the polarization between photons, the researchers used a phenomenon called entanglement, which a disbelieving Einstein derided. Since then, however, it's been shown to be real.

When two photons are entangled, "they have opposite luck," said IBM's Bennett. Whatever happens to one is the opposite of what happens to the other. In particular, their polarizations are the opposite of each other.

Here's how the Austrians took advantage of that:

Call three photons A, B and C, and assume the goal is to transmit A's polarization to C. The researchers created B and C as entangled photons. Then they entangled B with A.

That second step destroyed A, but not before B took on the opposite of A's original state. This change meant B's entangled partner, C, had to change polarization to remain the opposite of B's. So C's polarization ended up the same as A's used to be. The polarization was transmitted.

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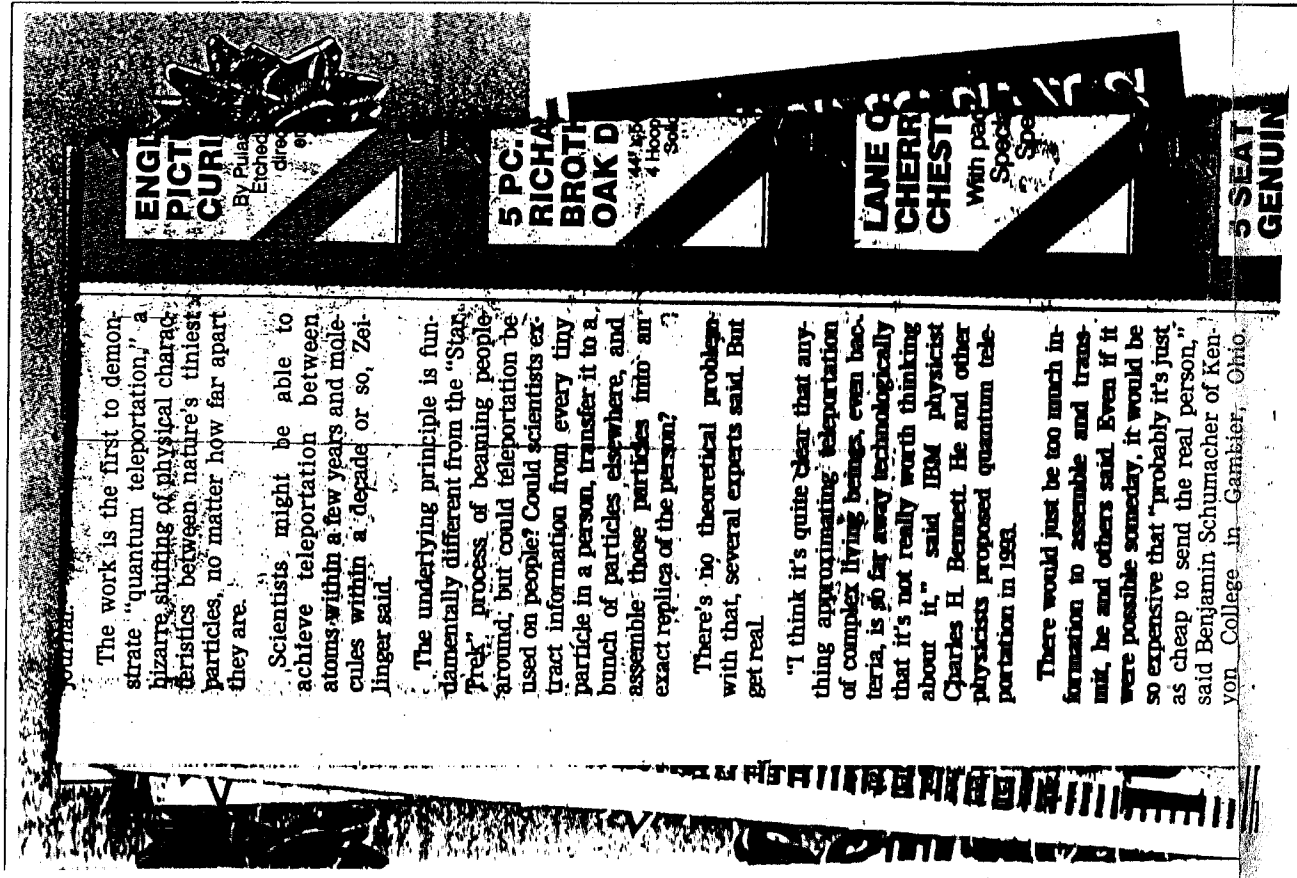

azo compound

{a'-zoh}

An azo compound consists of two organic molecules linked by two nitrogen atoms that share a double bond. This central unit (-N=N-) is called the azo group after azote, an early name for nitrogen. If the nitrogens are linked to atoms other than carbon in the aliphatic or aromatic molecules, the compounds are called diazo compounds.

The simplest aromatic azo compound is azobenzene. Like all compounds containing the light-absorbing azo group, it is colored--in this instance, a bright orange red. Unlike the thousands of other aromatic azo compounds that are industrially important dyes, it has no affinity with fiber, but it is used as an intermediate in the synthesis of such dyes and as an accelerator in the vulcanization of rubber.

zeolite

{zee'-uh-lyt}

Zeolites are SILICATE MINERALS found in volcanic and sedimentary rocks in arid regions and on the seafloor. They also occur as crystals in pockets within basalt flows and other volcanic deposits. Zeolites have unusual properties that make them valuable as filtering agents, and a number of synthetic zeolites have been developed to take advantage of these properties.

Properties

The structure of zeolite atoms gives these minerals their unusual properties. Zeolites are framework aluminum silicates, composed of tetrahedral atomic groups of SiO(4) and AlO(4), linked to form complex, three-dimensional networks. Other ions, chiefly sodium (Na) and calcium (Ca), are housed in cavities in the frameworks. In these respects the zeolites are like the feldspar and feldspathoid minerals, two other groups of framework silicates. The frameworks of zeolites, however, are much more open than those of feldspars and feldspathoids and contain channels large enough for ions to enter or leave the structures. This property, called ion exchange, is important in the use of zeolites for filtering. In many zeolites the channels are open enough to trap organic or other large molecules; such zeolites are called molecular sieves. All the zeolites contain water molecules, within structural cavities, that can be driven off by heating and recaptured when the zeolite cools.

Most zeolites are pale in color. Because of their open structures, zeolites have lower densities (2 to 2.3 g/cu cm) than feldspars (2.6 to 2.7 g/cu cm). Zeolites forming rock masses are fine-grained and can be identified only by microscope or X-ray diffraction studies. Those occurring in pockets may display beautiful crystals of numerous forms, from sprays of stilbite shaped like bow ties or sheaves of wheat to the fine needles of natrolite and mesolite. More than 30 different natural zeolites are known.

Occurrence

The best-known occurrence of zeolites is as crystals in gas pockets, within basalt and other volcanic rocks. A number of regions, including the Paterson area in New Jersey and the Columbia River Plateau of Washington and Oregon, are famous for their beautiful zeolite specimens.

In recent years zeolites have been found to be abundant in volcanic ash exposed to the waters of saline lakes in arid regions and in volcanic material on the seafloor. Huge deposits of fine-grained zeolites, potentially of great commercial value, have been found in the western United States.

Uses

The cation-exchange and molecular-sieve properties of zeolites make them important in a large number of filtering processes. Because calcium, but not sodium, reacts with water to form scum, synthetic zeolites are used as water softeners, removing calcium from water and replacing it with sodium. Zeolites can also be used to remove radioactive cesium and strontium from waters contaminated with these elements. Because of their differing structures, particular zeolites can be

Polarization of Light

The moving points of a transverse wave describe the vibration of the electric field, or vector, of the light wave. (The magnetic field is considered ineffective and may be ignored in the study of visible light.) If the electric vectors of a group of transverse waves are at random angles, in all directions, the light is said to be unpolarized. Conversely, if the electric vectors are all along the same plane, the light is said to be polarized. Some materials can introduce phase differences between two sets of polarized waves, to separate them or to analyze their states of polarization. Other materials, called polarizers, transmit only waves with electric vectors in one plane (the remaining waves are either reflected or absorbed, as in some sunglasses).

Angel –

angel, according to many religions, is a spiritual being created by God. The word *angel* comes from a Greek word meaning *messenger* or *one who is sent.* According to religious tradition, angels live in heaven and act as God's servants and as messengers between God and human beings. They also serve as guardians of individuals and nations. Angels traditionally are pictured as having a human body and wings. Poets and artists have portrayed angels as symbols of innocence or virtue.

Many religions have teachings about angels or similar beings. In some primitive religions, legends tell of bright, powerful spirits that appear in dreams and visions and protect people or tribes. In Hinduism and Buddhism, many major gods are accompanied by a band or court of spiritual beings.

light (līt) *noun*

1. *Physics.* **a.** Electromagnetic radiation that has a wavelength in the range from about 4,000 (violet) to about 7,700 (red) angstroms and may be perceived by the normal unaided human eye. **b.** Electromagnetic radiation of any wavelength.

ang·strom

ang·strom or **ång·strom** (ăng′strəm) *noun*
Abbr. **angst**, **Å**, **A**

A unit of length equal to one hundred-millionth (10^{-8}) of a centimeter, used especially to specify radiation wavelengths. Also called *angstrom unit.*

[After Anders Jonas Ångström.] – Discovered Angels.

polarizing filter

polarizing filter (pō′lər-ī-zēng fil′tər) *noun*

A transparent piece of glass or plastic that polarizes the light passing through it—that is, it allows only waves vibrating in a certain direction to pass through. Polarizing filters are often used to reduce glare on monitor screens. *See also* glare filter.

Optics

Optics, branch of physical science dealing with the qualities and action of electromagnetic waves from X rays to microwaves, including visible light (*see* Electromagnetic Radiation; Spectrum). The study of optics is divided into geometrical and physical optics. Geometrical optics applies the laws of reflection and refraction of light to the design of lenses. Physical optics studies polarization, interference, diffraction, and the emission, composition, and absorption of light.

Nature of Light

Radiant energy obeys laws that may be explained in terms of a stream of packets of energy, called photons, or in terms of a train of transverse waves (*see* Radiation; Wave Motion). The concept of photons is used to explain the interactions of light and matter that produce a change in the form of energy. The concept of transverse waves is used to explain the passage of light through substances and some facts of image formation.

Transverse waves may be described as a set of points moving back and forth perpendicularly to the direction the wave is advancing. A wave's frequency is the number of complete motions back and forth per second of any point on the wave. The wavelength is the distance between two points in the same phase, or occupying equivalent positions in the back and forth motion. Differences in wavelength are visible as differences in color in visible light. The velocity of an electromagnetic wave is the product of the frequency times the wavelength. In a vacuum, this velocity is the same for all wavelengths. The ratio of this velocity in a vacuum to the velocity of a particular wavelength of light in a substance is called the substance's index of refraction.

Reflection and Refraction

The laws of reflection and refraction of light are usually stated using the wave theory of light introduced by Dutch scientist Christiaan Huygens. For simplicity, however, in geometrical optics the passage of light may be represented by rays showing the direction of travel.

The amount of light reflected at the boundary of two substances depends on the ratio of their refractive indexes. The angle of incidence (for reflection or refraction) is the angle between the arriving ray and a line perpendicular to the surface. Snell's law, named after Dutch mathematician Willebrod Von Roijen Snell, states that the product of the refractive index and the sine of the angle of incidence of a ray in one substance is equal to the product of the refractive index and the sine of the angle of refraction in the next substance (*see* Trigonometry).

Generally, the refractive index of a dense transparent substance is higher than that of a less dense substance; that is, the velocity of light is lower in the denser substance (*see* Density). If a ray arrives at an angle, in a substance with a higher refractive index it is bent toward the perpendicular, and in a substance with a lower refractive index it is bent away from the perpendicular.

At an angle of incidence known as the critical angle, the refracted ray makes an angle of 90° with the perpendicular and travels along the boundary between the two substances. If the angle of incidence is increased beyond the critical angle, the ray will be totally reflected back. Fiber optics is an application of such reflection.

Polarization of Light

The moving points of a transverse wave describe the vibration of the electric field, or vector, of the light wave. (The magnetic field is considered ineffective and may be ignored in the study of visible light.) If the electric vectors of a group of transverse waves are at random angles, in all directions, the light is said to be unpolarized. Conversely, if the electric vectors are all along the same plane, the light is said to be polarized. Some materials can introduce phase differences between two sets of polarized waves, to separate them or to analyze their states of polarization. Other materials, called polarizers, transmit only waves with electric vectors in one plane (the remaining waves are either reflected or absorbed, as in some sunglasses).

Interference and Diffraction

When two light beams cross, they may interfere, interacting in a way that affects the resultant intensity. The effect depends on the degree of coherence, the extent to which waves are in phase and of one wavelength. If the phase relationship between waves changes rapidly and randomly, the two beams are incoherent. If two waves share phase, they are coherent, and if the maximum of one wave coincides with the maximum of another, the two waves combine to increased intensity. If two waves are coherent, and the maximum of one wave coincides with the minimum of another wave, the two waves will cancel each other. Atoms in an ordinary light source radiate independently, usually emitting incoherent radiation.

Light arriving at the edge of an object is *diffracted* (bent), blurring the object's shadow. The points on the edge of the object act as a source of coherent waves that interfere with each other. The shape of the edge of the object is not exactly reproduced because part of the wave front is cut off. Diffraction also occurs when light passes through

Descartes, René

79

Descartes, René (1596-1650), French philosopher, scientist, and mathematician, sometimes called the father of modern philosophy. Born in La Haye, Touraine (a region and former province of France), Descartes studied law at the University of Poitiers and pursued a military career for several years. After spending several years traveling, he returned to France in 1628. While in France, Descartes devoted himself to the study of philosophy and experimented in the science of optics. In 1628 he moved to the Netherlands, where he spent most of the rest of his life.


René Descartes

Descartes's first major work, *Philosophical Essays* (1637), contains four parts: an essay on geometry, another on optics, a third on meteors, and *Discourse on Method*, describing his philosophical speculations. In 1649 Descartes was invited to the Swedish court to instruct the queen. He died of pneumonia the following year.

Descartes attempted to apply the rational inductive methods of science, and particularly of mathematics, to philosophy. In his philosophy, called Cartesianism, he held nothing true until he established grounds for believing it true. He expressed the single fact from which his investigations began with the famous words "*Cogito, ergo sum*" ("I think, therefore I am."). From this premise that a clear consciousness of his thinking proved his own existence, he argued the existence of God.

Descartes made significant contributions in science and mathematics. In optics he discovered the fundamental law of reflection: the angle of incidence is equal to the angle of reflection. He also paved the way for the undulatory theory of light. His most notable contribution to mathematics was the systematization of analytic geometry. Descartes was the first mathematician to classify curves according to the types of equations that produce them. He was the first to use the last letters of the alphabet to designate unknown quantities and the first letters to designate known ones. He also invented exponent notation and formulated the rule, known as Descartes's rule of signs, for finding the number of positive and negative roots for algebraic equations.

an opening such as a lens.

Stimulated Emission

The atoms in common light sources produce light by spontaneous emission. If an atom absorbs energy and one of its electrons is boosted to a higher orbital, the atom is said to be excited. When the electron drops back to a lower orbital, it emits light. If enough atoms are excited, stimulated emission can occur. Light of a particular wavelength can produce additional coherent light with the same phase and direction. Stimulated emission amplifies the amount of radiation with one wavelength. The material being excited is shaped or contained to form an interferometer in which the wavelength being amplified is reflected back and forth many times. A small fraction of this radiation is allowed through one of the mirrors of the interferometer. If visible light is being amplified by stimulated emission, the term *laser* is used. It comes from the first letters of some words in the phrase "light amplification by stimulated emission of radiation."